

**What is claimed is:**

1. A high performance dorsiflexion shoe for enveloping a foot (40) of a wearer, including the wearer's metatarsal-phalangeal joint (20), the shoe comprising

(a) a sole portion (24) having a ground-contacting surface (26), a forefoot region (30), a midfoot region (32) and a heel portion (34), and

(b) a constraining device (16) above the metatarsal-phalangeal joint;

wherein the forefoot region is made of a high density material, and has a thickness, measured in a direction perpendicular to the ground-contacting surface of the sole portion, greater than the thickness of the heel portion, thereby defining a dorsiflexion shoe having a characteristic angle ( $\alpha$ ) of declination from the forefoot region to the heel portion;

wherein the constraining device substantially constrains a wearer's metatarsal-phalangeal joints from movement when exercising, and

wherein the forefoot region has a curved form defined so as to further minimize flexion of the metatarsal-phalangeal joint during walking or running.

2. The shoe of claim 1, wherein the sole portion (24) is a component of a shell (12) which includes sidewall portions (22) extending upwardly from the sole portion to a circumferential edge (13) which surrounds the wearer's foot (40).

3. The shoe of claim 2, wherein the circumferential edge (13) is higher in the heel region (34) than in the forefoot region (30), thus giving the outward appearance of a plantarflex shoe.

4. The shoe of claim 1, wherein the forefoot region (30) includes at least one hard, high density insert (66, 162, 180, 182, 184, 186, 190) formed to follow the curvature of the sole portion (24).

5. The shoe of claim 4, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) includes reinforcing ribs (90).

6. The shoe of claim 4, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) includes slits (200) for defining the bending moment of inertia of the insert.

7. The shoe of claim 4, wherein the at least one insert (66, 162) extends from the forefoot region (30) to the midfoot region (32).
8. The shoe of claim 4, wherein the at least one insert (66, 162, 180) extends from the forefoot region (30) to an area adjacent the cuniform bones of the wearer.
9. The shoe of claim 4, wherein the at least one insert (184, 186, 190) extends from the forefoot region (30) to the heel portion (34).
10. The shoe of claim 5, wherein the ribs (90) pass through a softer endo layer (92) and thus, present an exposed surface (91).
11. The shoe of claim 10, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) is molded of a color different from the sole, so as to prominently expose the form of the ribs (90) on an outside surface (91) of the shoe (10).
12. The shoe of claim 1, wherein the angle ( $\alpha$ ) of declination is within the range of 1 degree to 15 degrees, preferably 5 degrees.
13. The shoe of claim 1 wherein the forefoot region (30) includes a reinforced, padded toe portion (64).
14. The shoe of claim 1, wherein the heel portion (34) is substantially comprised of a low density, viscous-like material.
15. The shoe of claim 1 wherein the forefoot region (30) has a varying thickness defining a ground contact surface (26) of a curved form which mimics the function of natural metatarsal-phalangeal flexion.
16. The shoe of claim 11, wherein the curved form includes a straight portion, extending approximately from the heel portion (34) to the forefoot region (30), and a curved portion (28), substantially tangentially extending from the straight portion, and then curving upward about the toe.
17. An adaptable shoe assembly wherein the assembly includes:
  - a shoe having a sole portion (24) of a pre-determined angle of inclination, adapted to receive an interchangeable insole (104, 104'); and

at least one insole which inserts into the shoe, the assembly changing the posture of a wearer's foot (40) from one angle in a range between dorsiflexion and plantarflexion to another angle in the range resulting in a shoe defined by an angle of declination different from the pre-determined angle.

18. The shoe of claim 17, wherein the sole portion (24) is a component of a shell (12) which includes sidewall portions (22) extending upwardly from the sole portion to a circumferential edge (13) which surrounds the wearer's foot.
19. The shoe of claim 18, wherein the circumferential edge (13) is higher in the heel region (34) than in the forefoot region (30), thus giving the outward appearance of a plantarflex shoe.
20. The shoe of claim 19, wherein the insole (104, 104') includes three dimensional structures (120) which interface with a mating surface on the sole so as to lock the insole and the sole together, thus minimizing relative motion therebetween.
21. The assembly of claim 17, wherein the shoe is of a substantially normal plantarflexion form in which the metatarsal-phalangeal restraining device (16) is adjustable over the metatarsal-phalangeal joints (20) of the wearer with or without an insole (104, 104') installed, and the foot-contacting portion (26) of the sole portion (24) of the shoe is of a form which suitably interfaces with the foot (40) so that, when the insole is not installed, the shoe functions as a conventional plantarflexion shoe.
22. The assembly of claim 17, wherein the at least one insole (104) has a weight (106) selected to provide a particular level of energy consumption during use.
23. The assembly of claim 17, wherein the assembly is adapted to receive one of at least two insoles (104, 104') which alternatively insert into the shoe, providing the wearer with the ability to select the angle ( $\alpha$ ) of declination, and thus the degree of dorsiflexion.
24. The assembly of claim 23, wherein the insoles (104, 104') are of a thickness selected in the range of between 2.5 mm and 15 mm, representing approximately 0 to 6 degree changes in dorsiflexion.
25. The assembly of claim 17, wherein the assembly is adapted to receive at least two insoles (104''), stacked one on the other, a first-installed insole having a lower surface which

conforms to the form of the shell, and an upper surface formed to adapt to a wear's foot, and the second-installed insole formed to conform to the top surface of the first-installed insole, itself having a top surface that conforms to a wearer's foot, thus providing the wearer with the ability to select the angle ( $\beta$ ) of declination, and thus the degree of dorsiflexion.

26. The assembly of claim 25, wherein the insoles (104, 104') are of a thickness selected in the range of between 2.5 mm and 15 mm, representing approximately 0 to 6 degree changes in dorsiflexion.
27. The assembly of claim 17, wherein the assembly includes at least two insoles (104) of substantially differing weights, which alternatively insert into the shoe, providing the wearer with the ability to select a weight (106) to provide a particular level of energy consumption during use.
28. The shoe of claim 17, wherein the forefoot region (30) includes at least one hard, high density insert (66, 162, 180, 182, 184, 186, 190) formed to follow the curvature of the sole portion (24).
29. The shoe of claim 29, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) includes reinforcing ribs (90).
30. The shoe of claim 29, wherein the ribs (90) pass through a softer endo layer (92) and thus, present an exposed surface (91).
31. The shoe of claim 30, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) is molded of a color different from the sole portion (24), so as to prominently expose the form of the ribs (90) on an outside surface of the shoe.
32. The shoe of claim 28, wherein the at least one insert (66, 162, 180, 182, 184, 186, 190) includes slits (200) for defining the bending moment of inertia of the insert.
33. The shoe of claim 28, wherein the at least one insert (66, 162) extends from the forefoot region to the midfoot region.
34. The shoe of claim 28, wherein the at least one insert (180) extends from the forefoot region to an area adjacent the cuniform bones of the wearer.

35. The shoe of claim 28, wherein the at least one insert (182, 184, 186, 190) extends from the forefoot region to the heel portion.

36. A high performance dorsiflexion shoe for enveloping a wearer's foot, the shoe comprising a sole portion (24) having a ground-contacting surface (26), a forefoot region (30), a midfoot region (32) and a heel portion (34), wherein the forefoot region includes a hard, high density insert (66, 162, 180, 182, 184, 186, 190) formed to follow the curvature of the sole portion, wherein the heel portion is made substantially of a soft, viscous-like material, the overall thickness of the sole portion being such that the angle ( $\alpha$ ) on declination is at most 0 degrees, and wherein the differences in deformation of the hard and the soft materials are defined so as to enable the sole portion to deform during exercise in a manner that creates the effect of a dorsiflexion shoe.